STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

TABLE OF CONTENTS

APPENDIX AF

SYSTEM AUDIT PROCEDURES FOR PAMS SAMPLING AND ANALYSIS PROGRAM

TABLE OF CONTENTS (cont.)

APPENDIX AF

SYSTEM AUDIT PROCEDURES FOR PAMS SAMPLING AND ANALYSIS PROGRAMS

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF.1

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

AF.1.0 SYSTEM AUDIT PROCEDURES FOR PAMS SAMPLING AND ANALYSIS PROGRAMS

AF.1.0.1 INTRODUCTION - A system audit of a Photochemical Assessment Monitoring Station (PAMS) sampling program is an on-site review and inspection of field sites and laboratory operations to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of PAMS sampling data. A system audit is normally conducted at the initiation of a new monitoring system and annually thereafter. A system audit includes an appraisal of the following program areas: network management, field and laboratory operations, data management and reporting, and quality assurance. On-site interviews should include a review of the data processing procedure from field acquisition through reporting into the information storage system (i.e., Laboratory Information Management System (LIMS), Aerometric Information Retrieval System (AIRS)).

The system audit is facilitated by the use of a questionnaire designed to provide information about specific portions of the overall program. This questionnaire can be used to provide a system audit of the whole program, or sections of it individually, to provide an audit on a portion of the program.

This procedure addresses the field and laboratory evaluations of a system and performance audit, including an evaluation of the field and laboratory standard operating procedures.

AF.1.0.2 PRELIMINARY ASSESSMENT AND SYSTEM AUDIT PLANNING - In performing a system audit of a given district, the auditor is seeking a complete and accurate picture of that district's current PAMS sampling operations. The auditor should perform the on-site inspections and interviews with key personnel, evaluate some PAMS sampling sites operated by the district, and scrutinize the data processing procedures.

AF.1.1 GUIDELINES FOR CONDUCTING SYSTEM AUDITS

A system audit should consist of three separate phases:
- Pre-audit Activities
- On-site Audit Activities
- Post-audit Activities

AF.1.1.1 PRE-AUDIT ACTIVITIES - At the beginning of each year, a tentative schedule for on-site system audits of the field sites and laboratories should be established. As part of this scheduling, the auditor should indicate any special requirements such as access to specific areas or observation of specific activities.

Approximately six weeks prior to the on-site audit, the auditor should arrange a tentative schedule for meetings with key personnel, as well as for inspection of selected ambient air quality measurement and analytical operations. The auditor should also inform the district that they will receive a questionnaire which is to be completed and returned to the auditor within one month. Once the completed questionnaire has been returned, it will be reviewed, and the auditor will prepare a checklist detailing specific points for discussion with district personnel. The auditor should contact the district and coordinate the on-site audit.

AF.1.1.2 ON-SITE AUDIT ACTIVITIES - The auditor should meet initially with the district's contact person or his/her designee to discuss the scope, duration, and activities involved with the audit. This would include whether performance audits will be conducted and of which instruments and/or systems. This should be followed by a meeting with key personnel identified from the completed questionnaire or indicated by the district. Key personnel to be interviewed during the audit are those individuals with the responsibilities for: field and laboratory operations, data management and reporting, and quality assurance/quality control (QA/QC). The checklist of detailed specific points may be discussed during these meetings.

Enough time and effort should be devoted to the system audit so the auditor has a clear understanding and complete documentation in the following areas:

1. Organization
   - organization, training, and background of key personnel
   - general information on status of air monitoring program, QA plan, and field and laboratory Standard Operating Procedures (SOP)

2. Field Operations
   - conformance with regulations and QA/QC requirements

- type of analyzers and samplers and conformance to 40 CFR Parts 53/58 requirements
- field procedures, standards, documentation
- frequency of zero/span, calibration, precision
- corrective actions, repeat sampling runs
- standards certification, frequency, traceability
- spare parts, tools, records of repair
- training as required or necessary
- data acquisition and handling reliability

3. Laboratory Operations
   - operational practices for manual methods
   - analytical methods used
   - use of SOP, QC use of blanks, duplicates, and calibrations
   - corrective actions, repeat sample analysis
   - documentation and traceability for standards
   - record keeping, chain-of-custody, logbooks
   - waste disposal, safety practices, adequacy of laboratory for needs
   - data acquisition, data flow, back up, and validation

4. Data Management
   - data flow from field and laboratory to data processing
   - overview of data entry, automatic or manual
   - control check methods: if automatic, software and system
   - system backup and recovery capabilities
   - data screening, flagging, validation, correction (who may correct?)
   - type of reports and responsibility for final validation

5. QA/QC Programs
   - status and implementation of procedures
   - outside audits
   - internal audits such as document reviews or data processing
   - implementation of corrective action
   - frequency, levels, and results of precision checks by pollutant

6. Reporting
   - precision and accuracy summaries
   - internal reports to track performance and corrective actions
   - summary of air data reports as required, completeness and validity

In order to facilitate gaining a complete understanding of the PAMS sampling and analysis program, the auditor should conduct a random spot check of the district's documentation and obtain sample copies of the following:

- logs (daily calibration checks, maintenance, etc.)
- calibration reports (field and laboratory)
- quarterly QC report
- monthly QC report
- organizational chart

Once the on-site system audit is complete, the auditor should meet again with key personnel and with the district's contact person or designee to present preliminary findings and possible recommendations. The auditor should state the audit results and include an indication of the potential data quality impact. This is also an opportunity for the district to provide feedback.

The potential data quality impact is based upon specific criteria, some of which are requirements, and others which are only recommendations to improve the quality of a program. Specific criteria which must be met are found in 40 CFR Parts 50, 53, and 58, and in the "Quality Assurance Handbook for Air Pollution Measurement Systems", Volume II.

AF.1.1.3 POST-AUDIT ACTIVITIES - The major post-audit activity is the preparation of the System and Performance Audit Report. The preparation of this audit report requires the auditor to compare the documented standard operating procedures with the observed accomplishments and deficiencies of the audit findings.

If the deficiencies are such that the regulations and/or requirements are not met, then Air Data Quality Action (AQDA) requests should be issued to the district. The AQDAs should note the pollutant, appropriate time period, and reason for the issuance, as well as the time allowed for the district to respond.

A preliminary draft System and Performance Audit Report is submitted to the audited district, together with a letter requesting comments and thanking the district personnel for their assistance, time, and cooperation.

If the district has written comments or questions concerning the audit report, they should be reviewed for incorporation into a final draft report within 30 days of receipt of the written comment. If no written comments are received within 30 calendar days from report date, the report will be formally distributed without further changes.

The System and Performance Audit Report should include the following:

- executive summary
- conclusion
- recommendations
- system audit objectives
- organization
- laboratory facility and operations
- field operations
- data management
- quality assurance and quality control
- performance audit
- data quality
- follow-up

The audit results should include information on the staff and equipment, network size and siting criteria, data management system, quality assurance and quality control functions, and on AQDAs issued, if any, including resolution of such AQDAs.

AF.1.2 CRITERIA FOR EVALUATION

AF.1.2.1 INTRODUCTION - A system audit is normally conducted in five steps. First, a questionnaire is sent to the district prior to the audit visit. The district should fill out the questionnaire as completely as possible and return it with sufficient documentation through the use of attachments. Second, the questionnaire is reviewed by the auditor to become familiar with the system operations and to determine any weaknesses and potential problem areas. Third, the on-site visit and interviews are scheduled. Fourth, a report with recommendations is prepared and discussed with the district. Fifth, the auditor follows up with a performance audit to determine if the recommendations were implemented.

For the field audit, the auditor should interview the site operator. For the laboratory audit, the auditor should interview the laboratory manager, any person who has direct analytical responsibility for PAMS sampling analysis, personnel associated with data validation, analysis, and reporting, and the person identified by the laboratory manager, who has responsibility for quality assurance. The information gathered from these interviews should be complete and up-to-date. The interviews should also present an adequate picture of the current and proposed levels of implementation of all quality assurance activities, including internal quality control. An evaluation of the data handling and processing, field and laboratory operations and procedures, QA/QC, and analytical process should be conducted at this time.

At the conclusion of the series of interviews and the evaluations, the auditor should inform the district contact person of the audit results and discuss any potential data-impacting problems uncovered. At this time, the auditor also explains the reporting procedures and schedule.

AF.1.2.2 QUESTIONNAIRE - An overall system audit questionnaire is intended for use when a complete system audit is being conducted. This questionnaire covers field as well as laboratory operations. The overall system audit questionnaire should be completed by the person responsible for the overall program and should be returned to the auditor.

The questionnaire, includes several areas including: the reporting organization homogeneity, general operation, staffing, network design, network operation, data and record keeping, and quality assurance. This questionnaire is intended to cover the management and organizational activities of the program.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF.2

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

AF.2.0 PAMS SYSTEM AUDIT QUESTIONNAIRE

Agency _____

Address _____

Phone Number _____

Organization Director _____

PAMS Program Supervisor _____

Data Management Supervisor _____

Quality Assurance Officer _____

Questionnaire Completed _____
(By) (Date)

On-site Visit
Date _____

Audit Team Members _____

Affiliation of Audit Team _____

TABLE OF CONTENTS

A. NETWORK MANAGEMENT

1. Staffing

a. Provide a current organizational chart indicating each responsible person's role in the current program.

b. Please include a list of educational background, experience, and training for each responsible person identified in the program organizational chart.

c. Is there adequate supervision to support the program? Yes[ ] No[ ]

d. Is there adequate staffing to support the program? Yes[ ] No[ ]

2. Reporting Organization Homogeneity

a. Are field operations conducted by a common team of field operators? Yes[ ] No[ ]

b. Are common calibration facilities used for all sites and laboratories? Yes[ ] No[ ]

c. Are precision and accuracy data reviewed by the District's quality assurance personnel for all sites and laboratories? Yes[ ] No[ ]

d. Are uniform procedures followed for data handling at all sites and laboratories? Yes[ ] No[ ]

e. Is a central data processing facility used for all reporting? Yes[ ] No[ ]

f. Is the traceability of all standards established by one or more central support laboratory/(ies)? Yes[ ] No[ ]
Who operates this/these laboratory/(ies)?
_____ _____

g. List all analytical laboratories which analyze manual methods for carbonyl and/or hydrocarbons._____
_____

3. Network Design

a. Are all sites documented according to specified criteria? Yes[ ] No[ ]

b. Has the network been designed in accordance with the stated program objectives? Yes[ ] No[ ]
Please include a brief description of any siting compromises.

c. Is there a written plan describing the overall network? Yes[ ] No[ ]
Title _____
Date _____

d. Does the organization have records identifying the status and history of each site, which includes:

1) site identification? Yes[ ] No[ ]
2) site coordinates and elevation? Yes[ ] No[ ]
3) date monitoring initiated? Yes[ ] No[ ]
4) model, manufacturer, and serial number of equipment at the site? Yes[ ] No[ ]
5) sampling schedule? Yes[ ] No[ ]
If yes, attach sampling schedule.

e. Is the equipment at all sites installed in accordance with manufacturer's specifications and/or regulatory guidelines? Yes[ ] No[ ]

f. Does the network design consider:

1) access? Yes[ ] No[ ]
2) power availability? Yes[ ] No[ ]
3) potential localized interferences such as closely located sources? Yes[ ] No[ ]

g. When was the PAMS sampling program initiated?

_____

h. How many sites are operated?

_____

4. General

a. List the sites at which the following PAMS equipment are operated:

1) NMOC (3 hr. canister)

2) Carbonyl

3) NMHC (continuous analyzer)

4) Ozone

5) NOx

6) NOy

7) Meteorological (include parameters measured)

8) Upper Air Meteorological

b. Please complete the following information:

Site	AIRS #	Operated Since	Collocated Sampler (Y/N)?	If Yes, Which?

c. Is a history of instrument changes (additions, replacements, removal, etc.) recorded in a logbook? Yes[ ] No[ ]

d. Has a quality assurance project plan been developed? Yes[ ] No[ ]
Date _____

B. FIELD OPERATIONS

1. Field operations

a. Is equipment in the network operated in accordance with the organization's standard operating procedures (where such exist)? Yes[ ] No[ ]

b. Are the operating procedures compatible with:
1) U.S. EPA guidelines? Yes[ ] No[ ]

2) manufacturer's recommendations? Yes[ ] No[ ]
3) ARB's Air Monitoring Quality Assurance SOP? Yes[ ] No[ ]

c. Are an adequate supply of spare parts and expendables maintained at the site or a regional office in order to avoid unnecessary down time? Yes[ ] No[ ]

d. List below the period of operation for each site.

_____

_____

e. Is a bound logbook maintained at all sites? Yes[ ] No[ ]
Does the logbook include:
1) records of all site visits? Yes[ ] No[ ]
2) problems and repairs? Yes[ ] No[ ]
3) maintenance? Yes[ ] No[ ]
4) data? Yes[ ] No[ ]

f. Is routine maintenance performed at all sites? Yes[ ] No[ ]
By whom? _____
(Name and position)

g. Does the person performing such maintenance have access to standard troubleshooting/maintenance procedures or instrument manuals? Yes[ ] No[ ]

h. Please describe how samples are shipped or transported to the analytical laboratory, if applicable.

_____

_____

i. Standard Operating Procedures (SOP)

1) Have the Standard Operating Procedures for Field Operations been developed? Yes[ ] No[ ]

Date _____

2) Have the Field SOPs been provided to the ARB's Quality Assurance Section? Yes[ ] No[ ]

3) Does the program operate in compliance with:
U.S. EPA protocol? Yes[ ] No[ ]
California's Alternative Plan Protocol? Yes[ ] No[ ]

g. How often are sites visited by the primary operator?
_____

h. How often are the samples removed (if applicable)?
_____

C. LABORATORY OPERATIONS

1. Laboratory Operations

a. Is equipment in the laboratory operated in accordance with the organization's standard operating procedures (where such exist)? Yes[ ] No[ ]

b. Are the operating procedures compatible with:
1) U.S. EPA guidelines? Yes[ ] No[ ]
2) manufacturer's recommendations? Yes[ ] No[ ]
3) ARB's Air Monitoring Quality Assurance SOP? Yes[ ] No[ ]

c. Is the equipment operated on a documented schedule? Yes[ ] No[ ]
(Please attach a copy.)

d. Are an adequate supply of spare parts and expendables maintained in the laboratory? Yes[ ] No[ ]

e. Is a bound logbook maintained at the laboratory? Yes[ ] No[ ]

Does the logbook include:
1. sample receipt and identification? Yes[ ] No[ ]
2. problems and repairs? Yes[ ] No[ ]
3. maintenance? Yes[ ] No[ ]
4. data? Yes[ ] No[ ]

f. Is routine maintenance performed on all instruments? Yes[ ] No[ ]
By whom? _____
(Name and position)

g. Does the person performing such maintenance have access to standard troubleshooting/maintenance procedures or instrument manuals? Yes[ ] No[ ]

h. Standard Operating Procedures (SOP)

1) Have the following been developed:
Standard Operating Procedures for Analytical Laboratory? Yes[ ] No[ ]
Date _____

Laboratory Quality Control Manual? Yes[ ] No[ ]
Date _____

2) Have the documents listed above been provided to the ARB's Quality Assurance Section? Yes[ ] No[ ]

3) Does the program operate in compliance with:
U.S. EPA protocol? Yes[ ] No[ ]
ARB protocol? Yes[ ] No[ ]

D. DATA AND RECORD KEEPING

1. Data Handling

a. Please indicate the data that is maintained and the data format:

1) field site data
   a) calibration data _____
   b) sample run data
   _____

2) field laboratory data
   _____

3) analytical laboratory data:
   a) analytical results _____
   b) calibration data _____

c) separate QC data _____

b. Are field data checked for reasonableness? Yes[ ] No[ ]

c. Are analytical laboratory data checked for reasonableness? Yes[ ] No[ ]

d. Are a portion of the data from the field verified by the laboratory (such as collocated sampling)? Yes[ ] No[ ]

e. Are replicate results tabulated and available for review? Yes[ ] No[ ]

f. Are cross-checks used to validate or flag data? Yes[ ] No[ ]

g. Is data capture checked for reasonableness and are periods of missing data and reason for the missing data recorded? Yes[ ] No[ ]

h. Please describe what corrective actions are taken for out-of-control situations.

_____

_____

_____

_____

i. Please describe how data are corrected or deleted for out-of-control situations.

_____

_____

2. Reporting

a. In what format are results reported (e.g., hard copy, diskette, electronically)?

_____

b. To which agency are the results reported (e.g., U.S. EPA, ARB, etc.)?
_____

c. Are precision and accuracy data reported? Yes[ ] No[ ]

d. To which agency are the precision and accuracy data reported?
_____

e. To whom specifically are the results reported (Name of person, Division/Section, title)?

_____

f. How often are the results forwarded to the reporting organization? _____

g. Where, how, and for how long are data stored?
_____

E. QUALITY ASSURANCE

1. Quality Assurance

a. Is there a defined quality assurance function on-going within the network? Yes[ ] No[ ]

b. Is this function independent of all routine operations? Yes[ ] No[ ]

c. Does the individual responsible for this function regularly evaluate or audit the following operations:

1) site operations (performance audits)? Yes[ ] No[ ]
2) site data? Yes[ ] No[ ]
3) analytical laboratory operations? Yes[ ] No[ ]
4) analytical laboratory data? Yes[ ] No[ ]

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF.3

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

AF.3.0 FIELD OPERATIONS EVALUATION

AF.3.0.1 INTRODUCTION - A field operations system audit follows the procedures outlined in Section AF.1.2, Criteria for Evaluation. The system audit consists of 3 steps: 1) sending a questionnaire to the district prior to the audit visit, 2) reviewing the completed questionnaire, and 3) conducting the on-site visit and interviews. It may be necessary to visit one or more of the air monitoring sites. Therefore, it is highly recommended that arrangements with the district be made in advance of the on-site visit.

During the on-site visit, the auditor should interview the site operator responsible for the PAMS sampler and or instruments, personnel associated with field data validation, analysis, and reporting, and the person identified who has responsibility for the quality assurance. The information gathered from these interviews should be accurate, and should present an adequate picture of the current and proposed levels of implementation of all quality assurance activities, including internal quality control. An evaluation of the data handling and processing, field operations and procedures, and QA/QC should be conducted at this time. This evaluation should consist of, at a minimum, a random verification of district records.

At the conclusion of the series of interviews and evaluations, the auditor should inform the district contact person of the audit results and discuss any potential data-impacting problems uncovered. At this time, the auditor also explains the reporting procedures and schedule.

AF.3.0.2 GENERAL GUIDANCE FOR SITE DOCUMENTATION - During the initial phase of network installation, each site should be documented using a site report form. This form should be completed by organization personnel to record station location, site classification, station instrumentation, topography, and important pollution sources (see ARB's Air Monitoring Quality Assurance Manual Volume II, Section 2.0.3). This documentation should be updated at least annually thereafter, to reflect the changes that occur at the sites (e.g., construction of a new building).

It is important that the information contained on such site documentation be verified as accurate. While it does not fall within the scope of the quality assurance function to prepare these site documents, the auditor should verify, for a small number of sites, that the information contained in such documents is accurate and complete. He/she should note any changes which may affect data quality and notify organization management of such problems. Of particular

importance in this regard are sites where collocated instrumentation has been placed; such data may be used to estimate measurement or data precision.

AF.3.0.3 SITE EVALUATION REPORTING - At the conclusion of a site evaluation or evaluation of a group of sites for a single organization, the auditor should prepare a brief written report (refer to Section AF.1.1.3). This report should indicate at least a discussion of observations made during the site visit as noted in the questionnaire and a copy of the site documentation used for the evaluation. Where major discrepancies are noted, additional information needs to be included. If further documentation has been provided by the auditor, a newly completed accurate site description document should be attached. Recommendations to improve siting should be included.

AF.3.0.4 QUESTIONNAIRE - A field operations questionnaire (if not part of the systems audit questionnaire) should be completed by every person involved in sample and data handling, operations of a field site, and field activities quality control. The completed questionnaire will provide information on site documentation and field site evaluation (see PAMS SYSTEM AUDIT QUESTIONNAIRE, Section B).

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF.4

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

AF.4.0 LABORATORY OPERATIONS EVALUATION

AF.4.0.1 PROCEDURE - A laboratory system audit follows the procedures outlined in Section AF.1.2, Criteria for Evaluation. That is, the system audit is conducted in three steps: 1) a questionnaire is sent to the analytical laboratory prior to the audit visit, 2) the questionnaire is reviewed by the auditor, and 3) the on-site visit and interviews are scheduled.

During the on-site visit, the auditor should interview the laboratory manager, any person who has direct analytical responsibility for PAMS sampling analysis, personnel associated with data validation, analysis, reporting, and the person identified by the laboratory manager who has responsibility for quality assurance. The information gathered from these interviews, complete and up-to-date, should present an adequate picture of the current and proposed levels of implementation of all quality assurance activities, including internal quality control. An evaluation of the data handling and processing, laboratory operations and procedures, QA/QC, and analytical process should be conducted at this time.

At the conclusion of the series of interviews and evaluations, the auditor should inform the laboratory manager of the audit results and discuss any potential data impacting problems uncovered. At this time, the auditor also explains the reporting procedures and schedule.

AF.4.0.2 QUESTIONNAIRE - A laboratory questionnaire (if not part of the system audit questionnaire) provides information on analytical methods, standard laboratory operations, data entry, data bank validation, laboratory quality control, and laboratory management. The laboratory system audit questionnaire should be completed by every person involved in the data entry and review process, and by every person responsible for the operation of an analytical instrument (see PAMS SYSTEM AUDIT QUESTIONNAIRE, Section C).

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENIX AF.5

SYSTEM AUDIT PROCEDURES
FOR
PAMS SAMPLING AND ANALYSIS PROGRAMS

MONITORING AND LABORATORY DIVISON

AUGUST 2002

AF.5.0 REFERENCES

1. 40 CFR 50, July 1996.

2. 40 CFR 53, July 1996.

3. 40 CFR 58, July 1996.

4. U.S. EPA "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II."

5. ARB "Air Monitoring Quality Assurance, Volume V".